ELE/MUS/COM 369G Technologies and Music

Spring 2020

Instructors: Prof. Ying Sun (Biomedical Engineering)
Prof. Ian Reyes (Communication Studies)
Prof. Eliane Aberdam (Music) --------- guest lectures

Office Location: Ying Sun: Engineering (FCAE) rm. 216; Office hours: TR 10-11 am, 3-4 pm
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Class Days/Time: TR 2:00-3:15 pm

Classroom: White Hall room 205

Prerequisites: Junior standing or permission of instructor

General Education Student Learning Outcomes:

- G–Grand Challenge – Exploration of multiple perspectives of areas of contemporary significance, including their ethical implications.
- A1 (full) – Understand and apply theories and methods of the science, technology, engineering, and mathematical (STEM) disciplines.

Course Description

Introduction to Western music tonal systems; orchestra instruments; mathematics and physics of musical acoustics; physiology of auditory system; audio engineering; microphones, amplifiers and speakers; software for synthesis; ethics in music industry.

Cross-Listing: ELE 369G is cross-listed with MUS 369G and COM 369G.

Course Goals

In this course you will learn about:

- The basics of the Western tonal music: scales, keys, time signatures, chords, notations, and history;
- Orchestra instruments: tone, range, and development history;
- Mathematics of music acoustics, harmonics, and musical temperaments;
- Physiology of human auditory system;
- Audio recording – amplifiers, speakers, and microphones;
- Digitized music: sampling rate, quantization, MP3, standards;
- Software: synthesis (Pro Tools), notation (FinaleNoteflight/PureData), MIDI;
- Electronic music, visual programming for music (Max), synthesis based on physical models (GENESIS), multimedia;
- Ethics and piracy: utilitarianism, reciprocity, the framework of political economics;
- Ethics: music industry, music copyright, performance rights, Digital Millennium Copyright Act (DMCA);

- Either a hands-on projects (flute, theremin, recording, synthesis) or a written report.

Upon successful completion of this course, you will be able to demonstrate:

- A comprehensive knowledge of music and music instruments in terms of the basic mathematical and physical principles.
- An understanding of how human auditory system perceives different sound frequencies.
- An understanding of the functionalities of software tools for music notation, recording, synthesis, and composition.
- An appreciation towards classical music and modern music.
- An understanding of the ethical responsibilities related to music copyright and performance right.
- Skills of applying technical knowledge to real-world examples including piano tuning, guitar construction, flute construction, music synthesis, and multitrack recording.
- An application of the knowledge learned to a hands-on project or a music technology problem.

STEM components:

The mathematics components in this course will be built up from what the students have already learned in high school such as logarithm and trigonometry. After a brief review of the fundamentals the students will apply these skills to computations of sound volume in decibel, frequencies of equal temperament scales, harmonic relationships, and sampling theory. It is assumed that the students have high school level knowledge of logarithms and trigonometry. This course contains all components in STEM, not just mathematics. Examples include

a) Science – human auditory system, vibrations, inharmonicity.
b) Technology – audio recording; software for notation, recording, and synthesis.
c) Engineering – guitar construction, flute construction, piano tuning, audio compression.
d) Mathematics – sound acoustics, equal temperament scales.

Ethics components:

Technologies including xerox copy, digital music, and Internet have made piracy easy, prevalent, and often incorrectly regarded as victimless [5]. The utilitarianism may fall short under the complexity of modern political economy [6]. The Golden Rule or reciprocity may be dysfunctional [7] without knowing issues pertaining to music production, ownership, and exploitation of cultural labor, products, and value [8]-[11]. These issues will be addressed under the framework of *Political Economic*s with the help of modern literature [5]-[11]. The students will be tested on these topics throughout the three exams.

Required Texts books – none.

Required Readings – Instructors' notes and handouts on various relevant topics posted on the course webpage, including excerpts from the following books:

1. Chaps. 4, 13. "Musical Instruments: History, Technology, and Performance of Instruments of Western Music" by Murray Campbell, Clive Greated, and Arnold Myers. ISBN 0198165048, 978-0198165040, Oxford University Press, 2004.
2. Chaps. 3, 4. "Music Technology from Scratch" by Mortimer Rhind-Tutt. ISBN

1906178860, 9781906178864. Rhinegold Education, 2009.

3. Chaps. 1–3. "Musimathics: The Mathematical Foundations of Music (Volume 1)" by Gareth Loy. ISBN 0262516551, 978-0262516556, MIT Press, 2011.
4. Chap. 1. "Musimathics: The Mathematical Foundations of Music (Volume 2)" by Gareth Loy. ISBN 026251656X, 978-0262516563, MIT Press, 2011.
5. [Ethics] Carruthers J, Davies C, Parry G, Keppel-Palmer M. The epistemological foundations of music piracy in the digital marketplace. *Foresight and STI Governanc*e 9(4): 42-53, 2014.
6. [Ethics] Cleveland PA. The Failure of Utilitarian Ethics in Political Economy. *J. Private Enterprise* 18: 16–28, 2002.
7. [Ethics] Crisp V. To name a thief: constructing the deviant pirate. In: *Piracy: leakages from modernity*. Fredriksson M and Arvanitakis J, eds. Litwin Books, ISBN 9781936117598, pp. 39–53. 2014.
8. [Ethics] Holm HJ. Can economic theory explain piracy behavior? *B.E. Journal of Economic Analysis & Policy* 3(1): 1–18, 2003.
9. [Ethics] Easley RF. Ethical issues in the music industry response to innovation and piracy. *J Business Ethics* 62(2): 163–168 , 2005.
10. [Ethics] Panas EE, Ninni VE. Ethical decision making in electronic piracy: an explanatory model based on the diffusion of innovation theory and theory of planned behavior. *Int J Cyber Criminology* 5(2): 836–859, 2011.
11. [Ethics] Jackman M, Lorde T. Why buy when we can pirate? The role of intentions and willingness to pay in predicting piracy behavior. *Int J Social Economics* 41(9): 801–819, 2014.

Other equipment / material requirements (optional)

Musical instruments, audio engineering devices, and relevant software for demonstration purposes will be provided by the instructors and their home departments. The course project will be supported by the existing labs in each of the three departments.

Exams and Assignments

The grades will be based on Exam #1 (23%), Exam #2 (23%), Final exam (23%), and Project/Report (23%), Attendance (8%).

Course Project

Each students will choose a project to do. (For this semester, projects 1 and 3 are available.)

Project – Knowledge and technical skills learned from the lectures will be applied to a hands-on project. Examples of the projects include 1) a PVC-pipe flute, 2) an electronic theremin, 3) a digitally synthesized MP3 music clip, and 4) a multitrack-recorded music clip. The students can also propose their own projects, subject to the approval of the instructors. The hardware projects (flute and theremin) will be supported by the Biomedical Engineering Laboratory (BME Lab) for materials and tools. The BME Lab is temporarily located off campus at the Schneider Electric building, 132 Fairgrounds road, West Kingston, RI. A free bus shuttle travels between Memorial Union and Schneider Electric approximately every ½ hour. A help section in addition

to the regular classroom meetings will be held at the BME Lab. The synthesized music and multitrack recording projects will be supported by laboratories in the Dept. of Music and the Dept. Communication Studies on the URI campus. In addition to the final product, a short technical report needs to be submitted that includes the design strategy, development process, and test results.

Grading Policy

A	94-100	B-	80-82	D+	67-69
A-	90-93	C+	77-79	D	60-66
B+	87-89	C	73-76	F	<60
B	83-86	C-	70-72		

Instructor Policies

Students are expected to attend all the lectures, participate in classroom activities, arrive on time, stay for the entire class, and take the exams at the scheduled times. Occasionally, students may miss class activities due to illness, severe weather, or sanctioned University events including religious holidays. If ill, students should not attend class and should seek medical attention especially if they have a communicable disease such as influenza.

Academic Honesty & Integrity

The exams will be open-book and open-notes. You are allowed to use electronic devices such as electronic notebook, tablet, smartphone, and/or laptop. However, you are not allowed to communicate with another person in any form. Should you make any unauthorized communication during the exam, you will be charged with plagiarism and will receive an F for the exam. In some cases, this may result in a failure of the course as well. In addition, the charge of academic dishonesty will go on your record in the Office of Student Life.

Classroom Protocol

Our course webpage is at <http://www.ele.uri.edu/courses/ele369g>, which will be constantly updated for handouts, announcements, and sample exams.

Accommodations for Special Needs

Any student with a documented disability is welcome to contact me as early in the semester as possible so that we may arrange reasonable accommodations. As part of this process, please be in touch with Disability Services for Students Office at 302 Memorial Union, Phone 401-874-2098.

Table 1 Course Weekly Schedule

Wk	Date	Topics	Handout
1	1/23	Introduction; Orchestra instruments; Pre-class survey (Sun,, Reyes)	01a, 01c
2	1/28 1/31	Music acoustics, harmonics, musical temperaments (Sun) Mathematics of musical temperament, scales, chords (Sun)	03a 04c
3	2/4 2/6	Vibrations, geometric series, scales; Sound intensity in dB (Sun) Multi-Disciplinary Studies of Music Technologies I (Reyes)	05a 03b_E, 03c_E
4	2/11 2/13	Multi-Disciplinary Studies of Music Technologies II (Reyes) Harmony, chords, beating; Fourier analysis (Sun)	04a_E, 04b_E 04c
5	2/18 2/20	Sampling rate, quantization, data compression MP3; Preparation for Exam #1 (Sun) **Exam #1**	05b
6	2/25 2/27	Music synthesis software such as Audacity (Aberdam) Recording Studio Tools and Signal Flow (Reyes)	12a 07a
7	3/3 3/5	East Coast vs. West Coast Synthesis (Reyes) MIDI, notation software (Sun)	09a 6b, 6c
8	3/10	No class (Spring recess)	
9	3/17 3/19	Synthesis techniques, composition by modular patching (Ryan Campos) Virtual Modular Synthesis (Reyes)	 09b, 09c_E
10	3/24 3/26	Theremin; Preparation for Exam #2 (Sun) **Exam #2**	12e
11	3/31 4/2	Rhythm, time signature, meter and tempo (Aberdam) Intervals and scale formation, circle of fifths (Aberdam)	02a, 02b 02c, 02d, 02e
12	4/7 4/9	Project: synthesized music (Reyes); PVC pipe flute (Sun) Technology, Aesthetics, and the Music Industry (Reyes) Piracy, Streaming, and Consumer Ethics (Reyes)	12c 07b 12b
13	4/14 4/16	Physiology of human auditory system: anatomy and physiology (Sun) Physiology of human auditory system: hearing loss, cochlear implant (Sun)	06a
14	4/21 4/23	Acoustics of woodwind musical instruments (Sun) Inharmonicity and piano tuning; guitar construction (Sun)	12d 14a
15	4/28 4/30	Conclusion; Post-class survey; Preparation for Final Exam (Sun, Reyes) **Exam #3** Thursday 11:30 am – 1:00 pm	

Grading: Exam #1 (23%), Exam #2 (23%), Exam #3 (23%), Project (23%), Attendance (8%).
Extra 3% - Attending "Geoffrey Gibb's 80th Birthday Celebration" 3 pm, March 29, 2020, Fine Arts Center